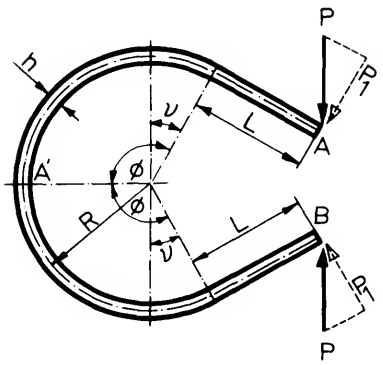

Fig. 26.10 General U spring.

If Y_1 is the displacement of loaded end A in the direction of P_1 and Y, the total change in the distance AB due to P, then

$$Y_1 = 0.5Y \cos \nu \tag{26.31}$$

From the previous results such as Eq. (25.39), we get

$$Y_1 = \frac{P_1 R^3}{EI} F(k, \phi) \tag{26.32}$$

where

$$F(k, \phi) = 0.33k^3 + k^2\phi + 2k(1 - \cos \phi) + 0.5\phi - 0.25 \sin 2\phi \tag{26.33}$$

Hence

$$Y = \frac{2PR^3}{EI} F(k, \phi) \tag{26.34}$$

The corresponding maximum bending stress at point A', Fig. 26.10, can be shown to be

$$S_b = \frac{6PR}{bh^2} \left(1 + \sin \nu + \frac{k}{\cos \nu}\right) \tag{26.35}$$

For the validity of Eq. (26.35), $\phi = \nu + \pi/2$. When, on the other hand, $\phi \leq \pi/2$, the foregoing stress formula becomes

$$S_b = \frac{6PR}{bh^2}(1 - \cos \phi + k \cos \nu) \tag{26.36}$$

For the special case of $\nu = 0$ and $\phi = \pi/2$, Eq. (26.36) reduces to

$$S_b = \frac{6PR(1 + k)}{bh^2} \tag{26.37}$$